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(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
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1. Your reference

JMP-02

08 MAY 1998

2. Patent application number
(The Patent Office will fill in this part)

9809902.1

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

MARLOWE, John
3 Dominic Road,
Childwall,
Liverpool.
L16 1JY.
England. U.K.

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

74334500

4. Title of the invention

"A MAGNETIC FILTRATION SYSTEM"

5. Name of your agent *(if you have one)*

N/ A

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Applicant's address

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*
N/A	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

NO

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Continuation sheets of this form	-
Description	7 pages (2 copies)
Claim(s)	-
Abstract	-
Drawing(s)	7 pages (2 copies)

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

John MARLOWE

Signature [signature]

Date 6th-5th-98

12. Name and daytime telephone number of person to contact in the United Kingdom

John MARLOWE Tel/ Fax. 0151 735 1447

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A MAGNETIC FILTRATION SYSTEM

- Description -

The present invention relates to a magnetic filtration system for filtering ferrous and some non-ferrous material from a fluid in which said material is in suspension.

The magnetic filter device of a previous application (9515352.4) (MARLOWE) comprises an annular magnet disposed between a pair of annular metal plates. Fluid flows into the device through recesses in the metal plates, and returns through the centre of the device when used in conjunction with a conventional filter.

Another device (FREI) uses a series of cylindrical magnets separated by a series of metal baffle plates, which are magnetised through contact with the magnets. The flux fields generated are designed to collect particles on the plates themselves and also around the edges of the perforations in the plates. A metal screen abuts the edges of the plates and is therefore magnetised through contact with it. The screen forms an envelope around the arrangement and is designed to increase the magnetised area in the actual flow path. Disadvantageously, however, the metal particles, which build up on the screen, form an ever-increasing obstruction to flow. In addition, any particles collected on the plates are exposed to the flow, and are in danger of being washed off.

A magnetic filtration system for filtering ferrous and some non-ferrous material from fluid, in which said material is in suspension, comprises inlet and outlet means. The system can advantageously be inserted at almost any point in a liquid or gas system. The filtration system comprises a housing in which a series of collection units are disposed. Ferrous and some non-ferrous particles drawn along with the ferrous particles can be collected in the collection units. Particles are advantageously held out of the flow path, and

therefore do not result in obstruction of flow. The collection units can be readily removed from the housing, to be dismantled, cleaned off and re-installed for re-use in the system.

The present invention is applicable to liquid or gas systems that are subject to high flow rate and pressure.

In accordance with one aspect of the present invention, a magnetic filtration system for filtering metallic material from a fluid in which said material is in suspension, comprises a housing having inlet means and outlet means, in which one or a plurality of collection units is disposed, each collection unit comprising one or a plurality of plates disposed either side of one or a plurality of magnets so that the plates have opposing polarities, wherein portions of the plates extend beyond part of the perimeter of the magnet, facing plates have one or a plurality of apertures in axial alignment, and wherein facing apertures define a region of magnetic repulsion, and facing plate portions define a region of magnetic attraction.

Advantageously, each collecting unit is further separated from an adjacent collecting unit by a non-magnetisable spacer, and the like poles of adjacent collection units facing so as to restrict the collection of metal particles to the inside of the collecting units.

Advantageously, the collection units are mounted on a unit having means for keeping the pole pieces and recesses, respectively, of each collection unit in axial and radial alignment.

Preferably, the magnetic filtration system is further provided with a device for enhancing fluid flow direction.

Preferably, slots are provided in said recesses and pole pieces, and facing pairs of pole pieces curved towards one another to further enhance the magnetic flux fields.

Advantageously, an internal surface of the housing is disposed close to the outer perimeters of the pole pieces so that all fluid flow is exposed to the magnetic flux fields generated in the filtration system. Alternatively, in a larger housing, one or a plurality of distribution plates having apertures in alignment with said recesses, can be inserted either side of one or more of the collection units to ensure that exposure of the fluid to the magnetic flux fields is optimised.

Preferably, the housing comprises one or a plurality of parts which can be readily assembled or dismantled, so that the mounted collection units can be inserted in the housing and sealed therein before use, and then when required, removed from the housing, cleaned of any collected metal debris and replaced inside for re-use.

Preferably, the housing is further made of a non-magnetisable material, and further provided with means for attachment to a fluid system.

Advantageously, means may be provided for isolating fluid flow from the filtration system to facilitate its removal from and replacement to the fluid system.

Advantageously, a device for monitoring the presence and/or amount of metal debris collected can be disposed in the filtration system, so that particle collection and therefore wear can be assessed without dismantling the system.

Specific embodiments of the present invention will now be described with reference to the accompanying drawings in which:

Figs. 1, 2, 4, 5, 6, 7, 8 and 9 show both internal plan view and cross-section of different embodiments of collection unit which can form part of a magnetic filtration system;

Fig. 1 is a collection unit having radially extending bar magnets;

Fig. 2 is a collection unit having circumferentially arranged bar magnets;

Fig. 3 is a perspective view of part of a further embodiment of a collection unit;

Fig. 4 shows a further embodiment of a collection unit;

Fig. 5 is a collection unit having radially extending apertures and a cylindrical magnet;

Fig. 6 is a collection unit having circumferentially arranged slots and a cylindrical magnet;

Fig. 7 shows other orientations and shapes of apertures for collection units;

Fig. 8 is collection unit having an annular magnet inside which the apertures are disposed

Fig. 9 is a collection unit having bar magnets and collection areas at the edges of the plates

Fig. 10 is a cross-section through a magnetic filtration system;

Fig. 11 is an exploded view of a stack of collection units;

Fig. 12 is a cross-section of a plurality of collection units, and

Fig. 13 is a cross-section through a magnetic filtration system with contaminant indicator means.

Figs. 1 to 9 show various embodiments of collection units. In fig.1, a collection unit 30 has magnets 31 having faces of the same magnetic polarity in contact with a collection plate 32. Faces of the magnets, of opposite polarity, are in contact with a further collection plate 33. One plate is magnetised North, the other South. Apertures 34 in the plates are passage means for fluid flow through the unit. In fig. 1, the magnets 31 are arranged radially. Fig. 2 has plates magnetised in a similar manner, but with the magnets arranged circumferentially.

Fig. 3 shows a collection unit or part of a collection unit having pairs of collection plates 35, 36 of opposite magnetic polarity, through contact with magnets 37. Adjacent collection plates 35 thus have like polarity.

A collection unit in fig. 4 has plates 38, 39 magnetised through contact with a magnet 40. Adjacent plates 38 have like polarity.

Collection units in figs. 5 and 6 have cylindrical magnets 41, opposite faces of which magnetise plates 43, 44, North and South respectively. Fig. 5 has radially extending apertures 45, and Fig. 6 has circumferentially arranged apertures 46.

The collection units in fig. 7 show other shapes of apertures 47, 48 for collection plates.

A collection unit in fig. 8 has collecting regions 49 arranged inside the aperture of an annular magnet 50. Plates 51, 52 abut opposite faces of the magnet 50.

Fig. 9 shows a collection unit having a plurality of radially arranged magnets 53 with like poles in abutment with a collection plate 54, opposite poles in abutment with a facing collection plate (not shown).

Referring to figs. 10 to 13, a collection unit 1 is formed from a pair of annular metal plates 2, 3 between which, an annular magnet 4 is disposed. Each plate is shaped to form pole pieces 5 and recesses 6, which are further provided with slots 7. One plate is polarised North, the other South through contact with the magnet 4. The unit 1 is mountable onto a non-magnetisable rod 8. A non-magnetisable spacer 9 is also mountable onto the rod so that it separates a further unit 1 to be mounted on after it. Adjacent units are oriented so that like poles on adjacent collecting units are facing. Further such units are mounted on the rod and separated in a similar manner. The rod is provided with an axial recess 10 on an outer face. The plates 2, 3 are further provided with a tab 11 on an internal

surface which locates into said recess 10, to ensure that the recesses 6 and pole pieces 5, respectively, of adjacent collecting units, are in radial and axial alignment.

A distribution plate 12 (shown in Figs. 10 and 13) of non-magnetisable material abuts the first plate in the line of flow. Retaining means 13 are disposed on one side of the distribution plate and in abutment with the last mounted collection unit to maintain the collection units in their axial locations. The rod 5 is further provided with flow distribution means 14.

The rod 5 mounted with collection units 1 is disposed in a housing 15 divided into two parts, which interconnect by means of threaded surfaces 16 and which can be sealed by means of sealing means 17. Detector means 18, 19 (Fig. 13) can be provided for detecting the presence of metal collected between said pairs of pole pieces. Said means could be mounted in the housing 15 and connected directly, or accessible remotely, to indicator means on the outside of the housing or to a remotely located indicator unit.

The detector means 18, 19 comprise an insulator 20 disposed in an aperture in the housing 15. A probe 21 made of conducting material, is disposed inside the insulator 20 so that one end of the probe protrudes into the collecting region between one of the pairs of pole pieces, and the other end of the probe remains outside the housing. Retaining means 22 retains a conducting connector 23 on the part of the probe 21 outside the housing. It also retains a sealing means 24 against the aperture in the housing and the insulator 20. The probe is connected to a display means (not shown) via the connector 23. The collection units are electrically connectable to the housing.

As fluid containing metal contaminant flows into the recesses 6, metal debris builds up between pairs of pole pieces 5. The circuit between the housing and the display

means is completed only when metal builds up between the pole piece pair to such an extent, that it bridges the gaps to the probe 21.

Detector means 18 disposed by the first collection unit encountered by the flow will then act as an indicator of early build up of debris in the filtration system.

Because some of the metal particles suspended in the fluid are removed as fluid first flows through a collection unit, the fluid which flows into the next collection unit therefore contains less metal contaminant. Thus, the collection unit furthest from the inlet will take the longest to fill with debris. Detector means 19 disposed by this collection unit will indicate when the fluid filtration system is substantially filled with contaminant.

The detector means could also be used to indicate the quantity of debris present, and not just its presence. In one example, once the circuit is connected, different amounts of debris will offer a lesser resistance to the passage of current in the circuit. Once calibrated, current or other readings could then relate to the amount of debris collected.

Greater numbers of collection units 1 can be stacked together (fig. 12) to further enhance the collection capacity of metallic debris, by the filtration system.

In a further embodiment, distribution plates are disposed at the plates nearest the inlet and outlet means, and between adjacent collection units.

In another embodiment, the distribution plate may be omitted depending on the flow rate required through the device and the clearance between the outer diameter of the metal plates and the housing.

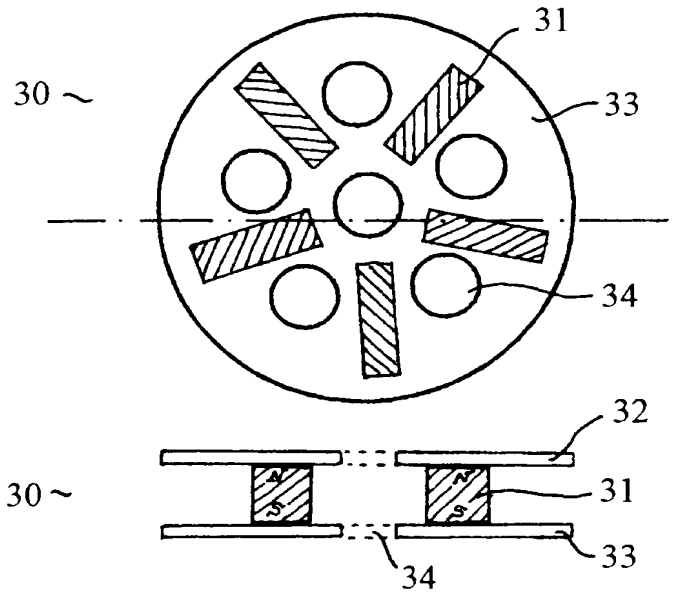


FIG. 1

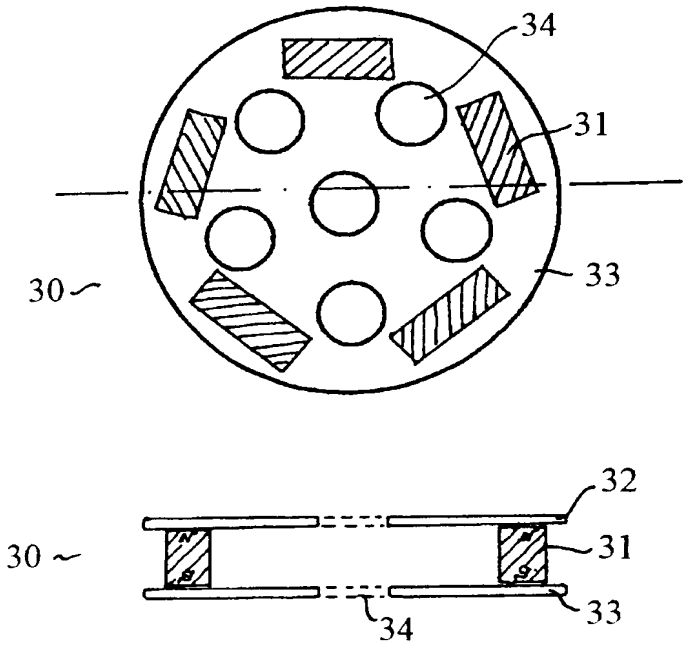


FIG. 2

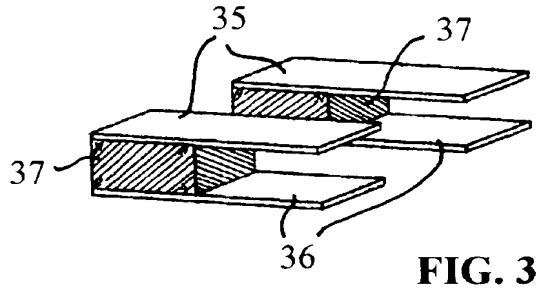


FIG. 3

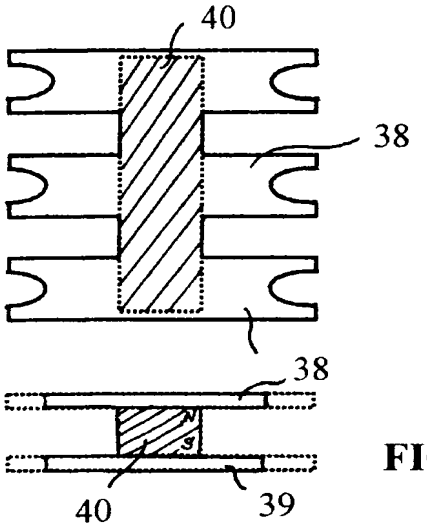


FIG. 4

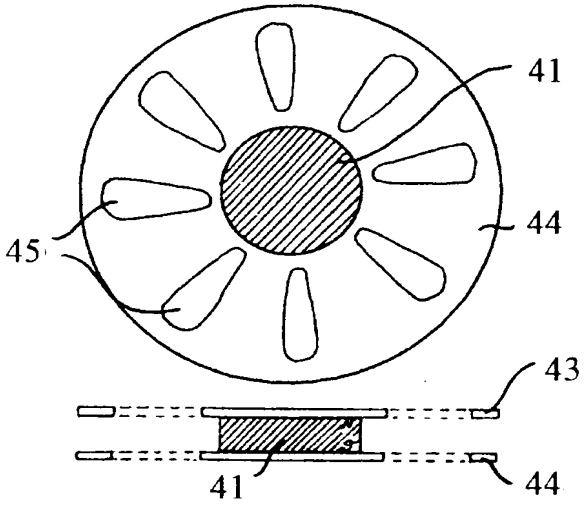


FIG. 5

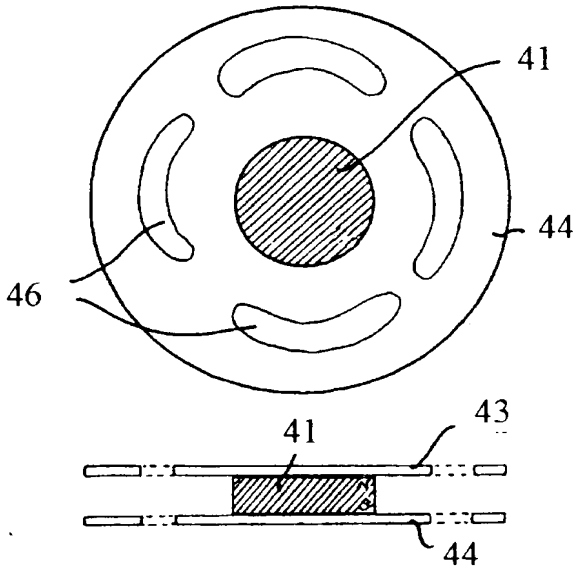


FIG. 6

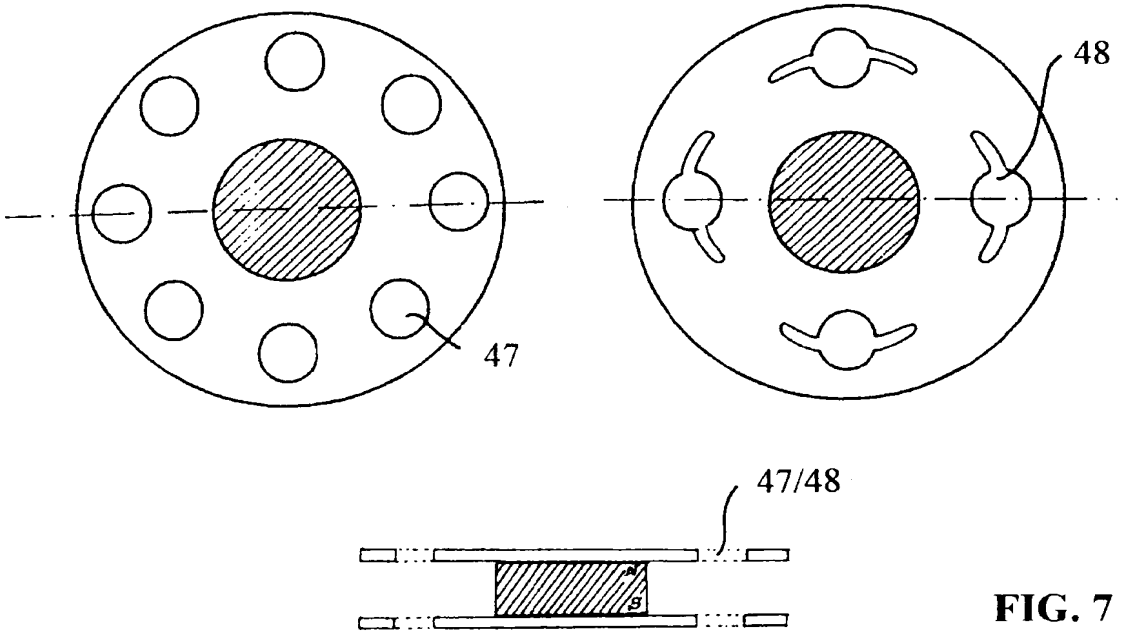


FIG. 7

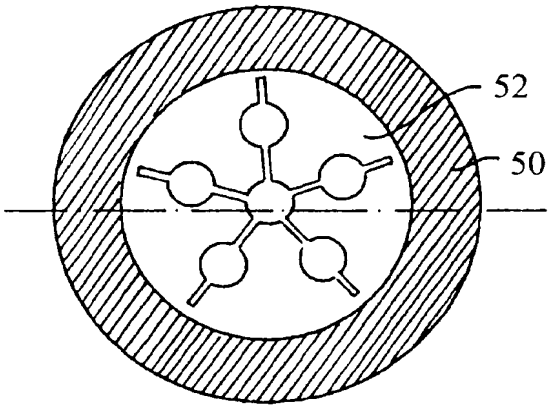
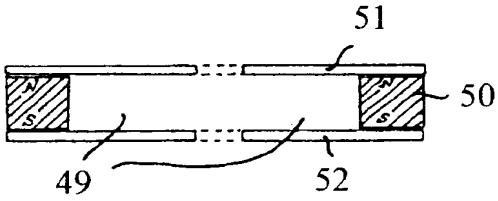


FIG. 8



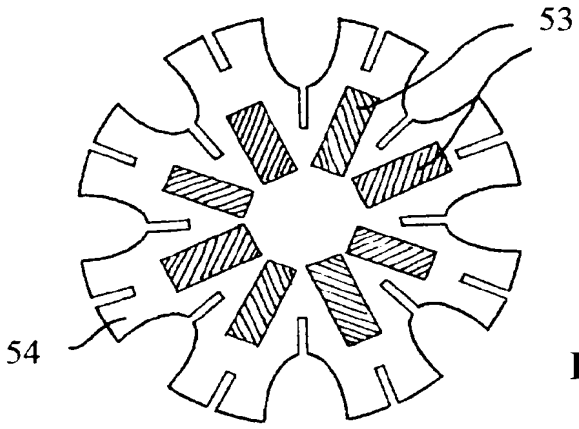


FIG. 9

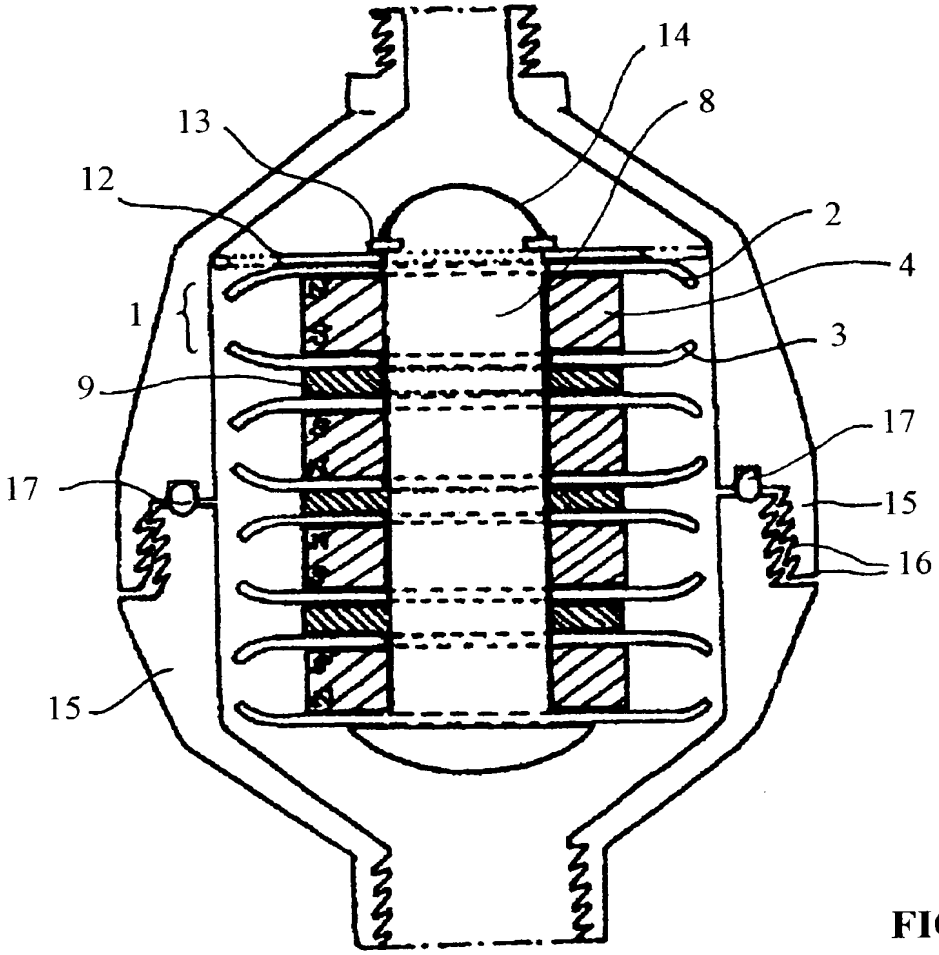


FIG. 10

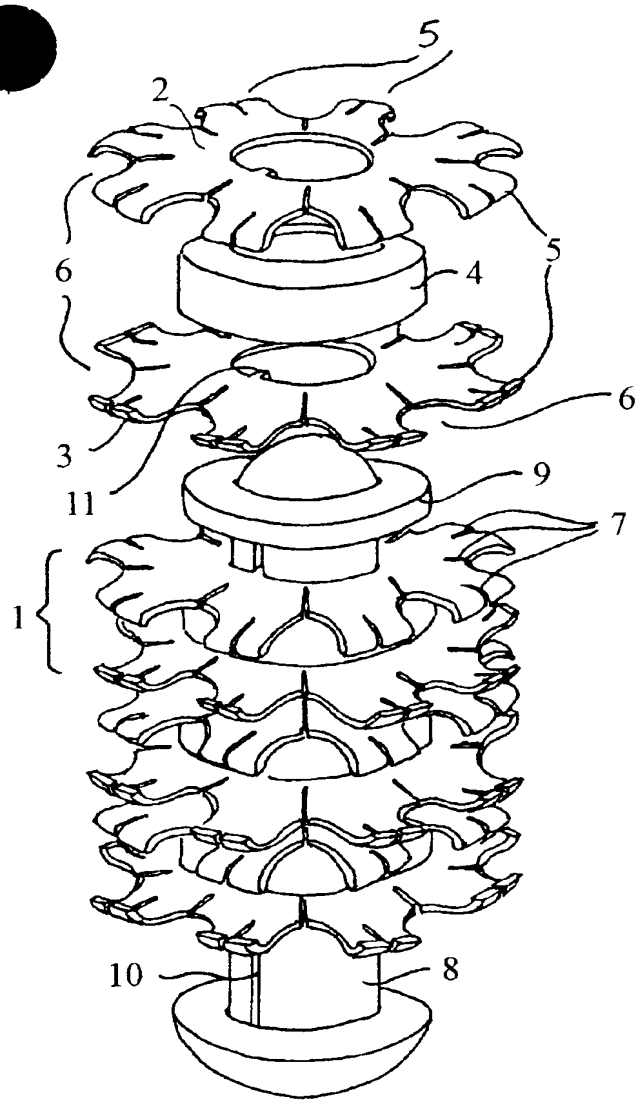


FIG. 11

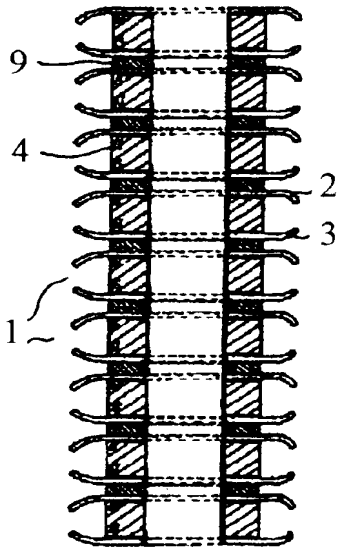


FIG. 12

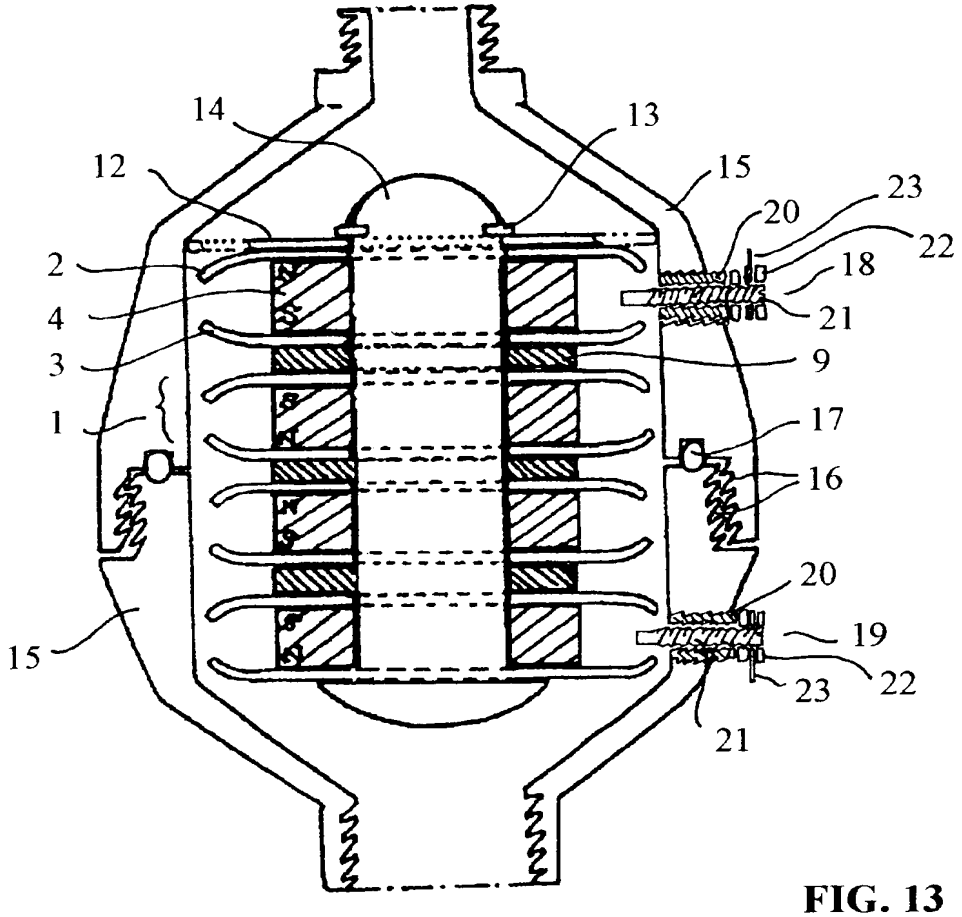


FIG. 13